OPTICS

Marshall Space Flight Center CDDF Success Story Number 3

Integrated Optics in Films of Organic and Polymeric Materials

The purposes of performing this work are to study thin film technology of organic and polymeric materials for improving applicability to optical circuitry and devices and to assess the contribution of convection on film quality in unit and microgravity environments. We seek to determine the potential role of microgravity on processing these materials. It is of interest to note how such materials (for optical computers, optical switching, and optical communications, memory storage, etc.) may be improved in a diffusion-limited environment and ways in which convection may be detrimental to these materials. For these reasons, materials processing techniques of general interest are solution-based and by physical vapor transport (PVT), both having proven gravitational acceleration dependence.

Quite specifically, although fibers have dramatically increased node to node network speeds, electronic switching will limit network speeds to about 50 Gb/sec. Already, it is apparent that terabit-rate speeds will soon be needed to accommodate the 5 to 10 percent per month growth rate of the Internet and the increasing demand for bandwidth intensive data such as digital video. One CDDF result worth noting involves the discovery of intrinsic optical bistability in metal-free phthalocyanine films which enables the possibility of the development of logic gate technology on the basis of these materials. Bistability in these films is due to changes in the level of absorption and refractive index caused by thermal excitation. Although further work must evolve to purely electronic excitations, this nonlinear effect could improve in highly oriented microgravity processed films.

Another product of this CDDF has been the study of polymeric materials applications for high-speed (pico-sec) spatial light modulation (the rapid transfer of electronic information to light waves having computational and telecommunications applications—device development on STS–95 in October 1998). The CDDF 97–07 activity prepared us to receive Code UX funding for this very important commercial activity involving a leading small optoelectronic company specializing in projection displays (relatively slow (milliseconds) spatial light modulation). The CDDF 97–07 work has also enabled our strong and active involvement with the Alliance for Nonlinear Optics (ANLO), an educational outreach alliance responsible for the basic design of the spatial light modulators expected to result from STS–95.

Finally, our work thus far is an invited chapter in a book entitled *Photonic Polymer Systems* (Chapter 17), in press by Marcel Dekker and scheduled for release in about April of this year. On the basis of our recent accomplishments and an adjunct to our general program, the future focus of the CDDF project will be refinement of spatial light modulator devices and the rigorous development of logic gates by methods exploiting the use of microgravity for processing.

Although this project is now far-reaching, the initial CDDF funding made crucial developments in this area of research possible. Because of this work, NASA plays a significant role in advancing the art of photonics and optoelectronics while establishing new areas of science and technology benefits from microgravity processing.